UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE & SOFTWARE ENGINEERING

MODULE	**IFM01B1 / IFM1B10** INTRODUCTION TO DATA STRUCTURES (VB)
CAMPUS	**APK**
EXAM	**NOVEMBER 2014**

DATE	2014-11-08	**SESSION**	08h30 – 10h30
ASSESSORS		MR D COTTERRELL DR WS LEUNG	
INTERNAL MODERATOR		MR M HEYDENRYCH	
DURATION	120 MINUTES	**MARKS**	100

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

INSTRUCTIONS:

- **ANSWER ALL QUESTIONS.**
- **PLEASE WRITE NEATLY AND LEGIBLY – THE LECTURERS RESERVE THE RIGHT TO NOT AWARD MARKS IF THEY CANNOT DISCERN WHAT WAS WRITTEN.**
- **DO NOT WRITE IN PENCIL – ANY ANSWERS IN PENCIL WILL NOT BE MARKED.**
- **IF A SHORT QUESTION IS OUT OF *X* MARKS, ONLY THE FIRST *X* ANSWERS PROVIDED WILL BE MARKED.**
- **CALCULATORS MAY NOT BE USED.**
- **ANSWERS MUST PERTAIN TO THE MATERIAL COVERED IN THE MODULE.**

QUESTION 1 (General Knowledge)

a) All programming languages such as Java, Visual Basic, and C++ can be categorised into one of three different **programming language categories**. **Name** them in the **order of least to most understandable** by a **machine**. (3)

b) **Describe** the **two-step process** that Visual Studio follows when **compiling .NET code** into an **executable program** to ensure the benefits of language and platform independence. (2)

c) Name the **two character encoding schemes** that were discussed during the course of the module. (2)

d) Explain the **difference** between a **class** and an **object**. (2)

e) On which **part of a computer** would one **store** an **external data structure**? (1)

[10]

QUESTION 2 (UML)

Demonstrate that you understand the concept of inheritance and composition by considering the class School.

a) Using the UML notation introduced during the course, give a single diagram that demonstrates the details (including relationships) of each of the following classes:

i) The class School

ii) One **composition class** linked to School (School is the component class)

iii) Two classes **derived** from School

Note:

- A total of **four** classes must be present in your diagram.
- Each class must contain at least **two attributes** and **one method**.
- Do **NOT** include:
  - **Property methods**
  - **Constructors**
  - **Overridden methods** (9)

b) In a second diagram, **draw** (not write) the **instantiation** of **one** of the **derived classes** (iii) you defined in Question 2a) above. (2)

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QUESTION 3 (Recursion)

a) In terms of a, b, and c, what does the following function calculate? (5)

```
1:  Private Function Recurse(ByVal a As Integer, _
2:                           ByVal b As Integer, ByVal c As Integer) as Integer
3:    If a < 1 Then              'Assume that a will always start >= 1
4:      Return (b * c)
5:    Else
6:      Return (b * c) * Recurse(a - 1, b, c)
7:    End If
8:  End Function
```

If you believe that the function calculates a + b + c, then your answer should be a + b + c.

Clearly indicate your final answer.

b) Recursion comprises a base case and a recursive call. Name one programming construct that could be used to achieve iteration. (1)

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QUESTION 4 (Programming)

Consider the classes Library, Park, City, Mayor, CityFacility, and frmSimulationCity.

Using the classes provided above, demonstrate that you understand the following programming concepts by writing sufficient and appropriate Visual Basic code (i.e. the code must be relevant to the above code snippets) to illustrate the concepts in question:

a) Composition (2)

b) **Constructor** for **above composition class** (all objects must be instantiated) (4)

c) A **protected utility** method (define AND make use of it) (5)

d) Overriding of method by **extending** its functionality (4)

e) Shadowing (and fix) (2)

f) **Shared** method (and **invocation** of the method in frmSimulationCity) (2)

g) Exception Handling that **guarantees** resource clean-up (4)

NB!!!

- Clearly indicate where each class begins and where each class ends.
- Clearly indicate where you are attempting to illustrate a particular concept in your code.

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QUESTION 5 (Collision Handling)

Assume that you have been provided with the following hash table for insertion into a random access file with 14 record positions. Given that the records are inserted into the file in the order tabled below, illustrate the contents of the full random access file if the following collision handling methods are used:

Key	Position
Z	3
Y	5
X	4
A	3
B	9
D	11
E	10
F	9
G	13
H	4

a) Linear search (5)

b) Synonym chaining (5)

c) Bucket addressing with bucket size 3 (5)

[15]

QUESTION 6 (Sequential Files)

Consider the classes `Room`, `Kitchen`, and `Bedroom` which will be used to develop a Visual Basic application that saves all Kitchens and Bedroom objects to a sequential file. Where applicable (this will be denoted by **{VB}** in the question), provide syntactically correct Visual Basic code (along with any necessary declarations) for the following questions:

a) Which classes require the `<Serializable()>` modifier? What is the modifier used for? (2)

b) Create a brand new sequential file, writing all the necessary objects to it before closing it. Declare and instantiate objects as necessary. **{VB}** (7)

c) Open the file for reading. (1)

d) Read the first object from the file. (2)

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QUESTION 7 (Random Access Files)

Consider the following record structure which must be used to save records in a random access file containing 29 records:

```
1:  Private Structure Fruit
2:      Public ID As Integer
3:      Public Name As String                ' Limit to 10 characters
4:      Public NutritionValue As Double
5:  End Structure
```

Where applicable (this will be denoted by **{VB}** in the question), provide syntactically correct Visual Basic code (along with any necessary declarations) for the following questions:

a) What is the total size of the record structure in bytes? Show your working out. (2)

b) Describe two strategies you will use to ensure that any information entered for the Name field will be limited to a maximum of 10 characters. (2)

c) Provide a subroutine that will create the random access file at the fixed location "C:\RandomFile.ifm". You may assume that the FileStr, a FileStream object has already been instantiated prior to the invocation of your subroutine. **{VB}** (7)

d) Provide a hash function called **CalcRecPos** that will return the **record position given** a **record key**. **{VB}** (2)

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QUESTION 8 (Social Aspects of IT)

Why is it important that an IT professional should be expected to behave ethically and responsibly?

Ensure that your discussion relates to social aspects that relate to Information Technology.

[10]

☺ THE END